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Organic carbon stock modelling for the quantification of the carbon sinks in terrestrial ecosystems

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Given the recent environmental policies derived from the serious threats caused by global change, practical measures to decrease net CO_2 emissions have to be put in place. Regarding this, carbon sequestration is a major measure to reduce atmospheric CO_2 concentrations within a short and medium term, where terrestrial ecosystems play a basic role as carbon sinks. Development of tools for quantification, assessment and management of organic carbon in ecosystems at different scales and management scenarios, it is essential to achieve these commitments. The aim of this study is to establish a methodological framework for the modeling of this tool, applied to a sustainable land use planning and management at spatial and temporal scale.

The methodology for carbon stock estimation in ecosystems is based on merger techniques between carbon stored in soils and aerial biomass. For this purpose, both spatial variability map of soil organic carbon (SOC) and algorithms for calculation of forest species biomass will be created.

For the modelling of the SOC spatial distribution at different map scales, it is necessary to fit in and screen the available information of soil database legacy. Subsequently, SOC modelling will be based on the SCORPAN model, a quantitative model use to assess the correlation among soil-forming factors measured at the same site location. These factors will be selected from both static (terrain morphometric variables) and dynamic variables (climatic variables and vegetation indexes –NDVI-), providing to the model the spatio-temporal characteristic. After the predictive model, spatial inference techniques will be used to achieve the final map and to extrapolate the data to unavailable information areas (automated random forest regression kriging). The estimated uncertainty will be calculated to assess the model performance at different scale approaches.

Organic carbon modelling of aerial biomass will be estimate using LiDAR (Light Detection And Ranging) algorithms. The available LiDAR databases will be used. LiDAR statistics (which describe the LiDAR cloud point data to calculate forest stand parameters) will be correlated with different canopy cover variables. The regression models applied to the total area will produce a continuous geo-information map to each canopy variable. The CO_2 estimation will be calculated by dry-mass conversion factors for each forest species (C kg-CO_2 kg equivalent).

The result is the organic carbon modelling at spatio-temporal scale with different levels of uncertainty associated to the predictive models and diverse detailed scales.

However, one of the main expected problems is due to the heterogeneous spatial distribution of the soil information, which influences on the prediction of the models at different spatial scales and, consequently, at SOC map scale. Besides this, the variability and mixture of the forest species of the aerial biomass decrease the accuracy assessment of the organic carbon.